

LISTING OF CLAIMS:

Claim 1 (currently amended): A color registration control system for a printing press having thereon a moving paper substrate, said system comprising:

an area scanner for acquiring an image of a paper substrate on a printing press; and
an image processing system adapted to receive the image and process the image to determine any color register error of the printing press, wherein said image processing system includes ~~the use of a hardware-based~~ a binary correlator implemented in hardware that operates on a plurality of pixel data values that are each a single bit, and is adapted to locate register marks on the paper substrate.

Claim 2 (original): The color registration control system as set forth in claim 1 wherein said binary correlator is implemented on an FPGA.

Claim 3 (original): The color registration control system as set forth in claim 1 wherein the area scanner is a CCD scanner.

Claims 4 (currently amended): The color registration control system as set forth in claim 1 and further including a light source generating illumination levels for said scanner ~~and wherein said image processing system further includes the use of a hardware-based histogrammer to process said illumination levels.~~

Claims 5-13 (cancelled)

Claim 14 (currently amended): A color registration control system for a printing press having thereon a moving paper substrate, said system comprising:

an area scanner for acquiring an image of a paper substrate on a printing press; and
an image processing system adapted to receive the image and process the image to determine any color register error, wherein said image processing system includes a ~~hardware-based~~ correlator adapted to locate register marks on the paper substrate and implemented substantially in hardware on at least one FPGA.

Claim 15 (currently amended): The color registration control system as set forth in claim 14 wherein said system ~~include~~ includes a binary correlator.

Claim 16 (currently amended): The color registration control system as set forth in claim 14 and further including a light source for illuminating a portion of the substrate ~~generating illumination levels, and wherein said components include a histogrammer adapted to produce a gray scale histogram of said illumination levels.~~

Claims 17-19 (cancelled)

Claim 20 (original): A color registration control system for a printing press having thereon a moving paper substrate and having a replaceable image processing subsystem, said control system comprising:

a scanner for acquiring an image of the paper substrate; and
an image processing system adapted to receive the image and process the image to determine any color register error, wherein said image processing subsystem is implemented on at least one FPGA, and wherein when it is desirable to change the image processing subsystem, said at least one FPGA is suitably re-programmed.

Claim 21 (new): A color registration control system in optical communication with a paper substrate moving in a circumferential direction in a printing press, comprising:

an image sensor for acquiring an image of the imprinted paper substrate; and

an image processing system adapted to receive and process the image to determine any color register error of the printing press, wherein the image is in the form of a plurality of pixels each having a corresponding data value, the image processing system including a binarizer for converting data values to corresponding single bit values according to a binarization level, and a binary correlator using the single bit values and operating to locate register marks on the imprinted paper substrate with respect to the circumferential direction on start up of the press.

Claim 22 (new): The color registration control system as set forth in claim 21, wherein the pixel data values are multi-bit gray scale values.

Claim 23 (new): The color registration control system as set forth in claim 21, wherein the image processing system further includes means for calculating the binarization level according to an analysis of the data values.

Claim 24 (new): The color registration control system as set forth in claim 23, wherein the data values are gray scale values and the analysis of the image includes analyzing the gray scale values.

Claim 25 (new): The color registration control system as set forth in claim 23, wherein the means for calculating the binarization level is a pixel histogrammer.

Claim 26 (new): The color registration control system as set forth in claim 21, wherein the binary correlator compares bits of an image portion to bits of a template image at a plurality of template image locations to compute a correlation value for each template location, and records template image locations having a corresponding correlation value greater than a predetermined correlation threshold.

Claim 27 (new): The color registration control system as set forth in claim 26, wherein the image processing system further includes a correlation histogrammer to calculate the predetermined correlation threshold for a subsequent correlation if the binary correlator produces few results.

Claim 28 (new): The color registration control system as set forth in claim 21, wherein the image processing system further receives an encoder signal from the printing press indicative of the circumferential position of a printing plate.

Claim 29 (new): A color registration control system in optical communication with a moving paper substrate in a printing press, said system comprising:

a camera for acquiring an image of the imprinted paper substrate in the printing press;
and

an image processing system adapted to receive and process the image to determine any color register error of the printing press, wherein the image is in the form of a plurality of pixels each having a corresponding data value, the image processing system including a binarizer for converting data values to corresponding single bit values according to a binarization level, a circuit for determining the binarization level according to an analysis of the data values, and a binary correlator using the single bit values and operating to locate register marks on the imprinted paper substrate.

Claim 30 (new): The color registration control system as set forth in claim 29, wherein the data values are multi-bit gray scale values, and the circuit for determining the binarization level is a pixel histogrammer for calculating the binarization level according to an analysis of the gray scale values of a given image.

Claim 31 (new): The color registration control system as set forth in claim 29, wherein the binary correlator compares bits of an image portion to bits of a template image at a plurality of template image locations to compute a correlation value for each template location, and records template image locations having a corresponding correlation value greater than a predetermined correlation threshold, and wherein the image processing system further includes a circuit for calculating the predetermined correlation threshold.

Claim 32 (new): The color registration control system as set forth in claim 29, wherein the image processing system further includes an interface circuit for acquisition of the image on demand, wherein the interface circuit is field programmable to allow for replacement of the image sensor.